# *PREFACE*

Since completion of this study, 48,000 acres of formerly private timberlands have been added to the Redwood National Park. Because the timber on those lands was considered available for harvest in this study, the timber output scenarios presented herein do not reflect the impacts of Park expansion on timing and magnitude of timber outputs. Although the scenarios would be slightly altered by recognition of the impacts of the Park expansion, the overall results and general conclusions of the study would not be affected.

# *PROSPECTS FOR SAWTIMBER OUTPUT IN CALIFORNIA'S NORTH COAST, 1975-2000*

## *Reference Abstract*

Oswald, Daniel D.
1978. Prospects for sawtimber output in California's North Coast, 1975-2000. USDA For. Serv. Resour. Bull. PNW-74, 20 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a study of sawtimber output alternatives for California's North Coast. Eleven "scenarios" of softwood sawtimber output from private lands are presented. The scenarios differ as to assumptions about rates and patterns of harvest and objectives pertaining to levels of output. Prospects for output from public lands are also discussed.

KEYWORDS: Forest product output, supply/demand (forest products), resources (forest), timber resources, California (north coast).

## *RESEARCH SUMMARY*

### *Resource Bulletin PNW-74*

### *1978*

This study was conducted to help determine the outlook for sawtimber output from California's North Coast. The study emphasizes future availability of private timber, which is of most importance to the region's timber economy; the contribution of allowable harvests from public lands is also discussed. The study focuses on softwood sawtimber availability over the next 25 years, a critical time period for the region's softwood-based timber economy.

Resource data for the study came from timber inventories conducted on all private lands in the North Coast in the mid-1960's. These inventories were updated to 1975, and then projected to year 2000 and beyond, on a stand by stand basis.

*Study Findings*

From 1967 through 1974, output from privately owned timber lands of the North Coast averaged 1.5 billion board feet of softwood sawtimber from growing stock, in addition to 150 million board feet of timber from cull trees and salvage material. During that period, harvest occurred on about 300,000 acres of private land and the region's private softwood sawtimber inventory declined 21 percent, to 26 billion board feet.

A number of "scenarios" were developed for future timber output from private lands of the North Coast. The scenarios differ as to assumptions about ordering of stands for harvest, rates of harvest, and output level objectives. Each represents a potential outcome only within the context of the assumptions associated with it. The scenarios are summarized in table 1.

Scenario I continues the patterns (by stand classes) and rates of harvest experienced from 1967 to 1974. Given that continuation, several of the most important stand classes will be exhausted in the next few years and output will drop sharply starting in 1981. Scenario I is unlikely to occur because, as some types of stands are exhausted, harvest activities will likely shift to other types of stands.

Table 1--*Alternative projections of softwood sawtimber output from private lands*[1] *of California's North Coast, 1975-2000*

(Million board feet)[2]

| Scenario[3] | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| I | 1,529 | 1,507 | 585 | 342 | 162 | 173 |
| II | 1,500 | 1,500 | 1,481 | 1,433 | 532 | 24 |
| III | 1,483 | 1,489 | 1,481 | 1,524 | 141 | 164 |
| IV | 1,511 | 1,498 | 1,458 | 1,507 | 223 | 278 |
| V | 1,216 | 1,047 | 895 | 877 | 857 | 885 |
| VI[4] | 1,579 | 1,559 | 1,537 | 1,294 | 80 | 24 |
| VII[4] | 1,564 | 1,485 | 1,287 | 823 | 469 | 521 |
| VIII[4] | 1,558 | 1,381 | 1,479 | 600 | 615 | 536 |
| IX[4] | 1,411 | 1,208 | 1,086 | 935 | 934 | 928 |
| X | 1,494 | 1,488 | 1,512 | 1,494 | 399 | 0 |
| XI | 1,483 | 1,489 | 1,190 | 1,193 | 160 | 194 |

[1] This study assumes that a constant output of 330 million board feet per year from public lands (within and adjoining the North Coast region) will be available to North Coast industries. Output from public timberlands is not included in this table.

[2] Scribner rule.

[3] Each scenario is an alternative projection of sawtimber output resulting from a unique set of assumptions.

[4] This scenario is the sum of two projections.

Scenarios II, III, and IV represent three different approaches to the objective of maintaining current output of private sawtimber for as long as possible. The three scenarios use different sets of priorities and rates of harvest for the sawtimber stands, but the outcomes are similar. In all three scenarios, 1.5 billion board feet of output can be maintained through 1994. Maintenance of output at recent levels however, can be accomplished only by rapid depletion of existing young timber stands, and leads to a precipitous falldown in 1995.

Scenario V demonstrates how the current private sawtimber stocks can be stretched over a 40-year period, thus giving the region's new forest stands time to mature. In essence it involves immediate declines in output as a means of saving sawtimber stocks for future harvest. If private sawtimber output is held at 1.2 billion board feet from 1975 through 1979, and 1.05 billion board feet from 1980 through 1984, adequate sawtimber stocks will remain to maintain sawtimber output at 850 to 900 million board feet until year 2014. This is but one of many possible alternatives that might make the falldown in private sawtimber output less precipitous but more immediate.

Scenarios VI, VII, VIII, and IX recognize differences in species types, major owners, and geographic location and assume that output from one of each set (of two species types, two owners, and two geographic areas) cannot substitute for the other. In all of these scenarios except IX, maintenance of current output was attempted.

Scenario VI indicates that sawtimber output from stands that are predominately redwood can be maintained (at 1 to 1.1 billion board feet) until the late 1980's; however, if so maintained, output will drop to 740 million board feet by 1990 and to less than 100 million board feet by 1995. Output from Douglas-fir (other conifer) sawtimber stands can be maintained at 400-500 million board feet until 1994, but by 1995 all sawtimber stands will have been harvested.

Scenario VII indicates that output from industry lands (1 billion board feet) can be maintained through 1984. From 1985 to 1989, 840 million board feet will be available annually, and by 1990 a decline to one-third of current output levels is indicated. Other private owners can maintain their output at 450-500 million board feet until beyond year 2000.

Scenario VIII develops output profiles separately for Mendocino-Sonoma and Humboldt-Del Norte. In Humboldt-Del Norte, recent output levels can be maintained through 1979; from 1980 through 1989, output can be maintained at 80 to 85 percent of recent levels. By 1990 most sawtimber stocks will be exhausted. In contrast, Mendocino-Sonoma has adequate sawtimber stocks to maintain output at about 500 million board feet to year 2000 and beyond.

Scenario IX is an alternative to VIII in which the Humboldt-Del Norte private output is "stretched" by scheduling immediate declines as a means of providing stocks for the latter part of this century. When combined with the Scenario VIII output for Mendocino-Sonoma, this alternative indicates that with an immediate decline extending to 1989, private sawtimber output in the North Coast might be maintained at about 930 million board feet from 1990 to 2004 (about 60 percent of recent levels).

Scenarios VIII and IX are perhaps the most useful of all the alternatives explored in this study. They indicate that the locus of declines in sawtimber output in the North Coast will be Humboldt-Del Norte. The high rates of harvest and rapidly declining sawtimber stocks in these counties underlie the regional declines in private sawtimber output indicated in the other scenarios.

In all of the scenarios having the objective of maintaining private output at current levels for as long as possible (II, III, IV, VI, VII, VIII, X, and XI), output could be maintained for as long as indicated in the scenarios only by rapidly depleting the young sawtimber stands and residual sawtimber stands, after the large sawtimber stands were gone.

### *Public Timber*

Publicly-owned commercial forests and commercial forests managed in trust by the Bureau of Indian Affairs constitute 25 percent of the region's timber lands. These forests, and public forests adjoining the North Coast Region, have produced 15-20 percent of the sawtimber processed in the region's mills in recent years.

Sawtimber from four National Forests provides raw material for the region's mills. In 1972, these four Forests (Six Rivers, Mendocino, Klamath, and Shasta-Trinity) were the source of 260 million board feet of sawtimber processed in the region. Assuming no significant changes in policy regarding allowable harvests, this is a reasonable estimate of raw material movement from the four forests to the region in the future.

Output from other public lands within the region has been almost 100 million board feet in recent years. However, all three land-managing agencies (State, BLM, BIA) recently reduced their allowable harvests to 71 million board feet (combined). In total, public lands might be expected to provide 330 million board feet annually for the region's timber economy, about 17 percent of recent levels of sawtimber output.

*Conclusions*

The following general conclusions can be drawn from the study:

1. Output of softwood sawtimber from the North Coast's private timberlands will decline substantially in the next 10 to 15 years.
2. The decline will be centered in Humboldt-Del Norte Counties.
3. No reordering of cutting priorities among the different types of sawtimber stands will have significant impact on the prospective falldown in output.
4. Output will decline in both Douglas-fir and redwood stands.
5. There are not sufficient sawtimber stocks to maintain recent levels of output until new stands, regenerated since the mid-1950's, reach merchantable sawtimber size.
6. Forest industry timberlands will show substantial decreases in output within 10 years; on other private timber lands, output can be maintained throughout the study period, assuming availability for harvest of all of these lands.
7. Output from public lands within and adjoining the region is not likely to offset declines in the private sector.

# TABLE OF CONTENTS

Page

INTRODUCTION . . . . . . . . . . . . . . . . . . . . . . . . 1

PROCEDURES . . . . . . . . . . . . . . . . . . . . . . . . 2
  The forest inventory data base . . . . . . . . . . . . . 2
  Predictions of stand growth . . . . . . . . . . . . . . 6
  Development of sawtimber harvest information . . . . . . . 7

THE NORTH COAST REGION'S PRIVATE SAWTIMBER RESOURCES, 1975 . . . . . . . . . . . . . . . . 9

SOFTWOOD SAWTIMBER OUTPUT ALTERNATIVES FROM PRIVATE LANDS IN THE NORTH COAST REGION . . . . . . . . . . . . . . . . . . . . . . . . 10
  Scenario I . . . . . . . . . . . . . . . . . . . . . . . 10
  Scenario II . . . . . . . . . . . . . . . . . . . . . . 11
  Scenario III . . . . . . . . . . . . . . . . . . . . . . 11
  Scenario IV . . . . . . . . . . . . . . . . . . . . . . 11
  Scenario V . . . . . . . . . . . . . . . . . . . . . . . 12
  Scenario VI . . . . . . . . . . . . . . . . . . . . . . 13
  Scenario VII . . . . . . . . . . . . . . . . . . . . . . 13
  Scenario VIII . . . . . . . . . . . . . . . . . . . . . 14
  Scenario IX . . . . . . . . . . . . . . . . . . . . . . 16

IMPACTS OF MAJOR ASSUMPTIONS . . . . . . . . . . . . . . . 16
  Scenario X . . . . . . . . . . . . . . . . . . . . . . . 17
  Scenario XI . . . . . . . . . . . . . . . . . . . . . . 17

OUTPUT OF SAWTIMBER FROM PUBLIC LANDS . . . . . . . . . . . . . . . . . . . . . . . . 18

CONCLUSIONS . . . . . . . . . . . . . . . . . . . . . . . 19

LITERATURE CITED . . . . . . . . . . . . . . . . . . . . . 20

# *INTRODUCTION*

The timber resources of California's North Coast have made this region an important producer of timber products for California and the Nation's forest products markets for many decades. In recent years, there has been considerable debate about the North Coast's future as a timber producing region. In the mid-1960's, and again in the 1970's, that debate was touched off by proposals first to establish, and now to enlarge the Redwood National Park. The debate has focused mainly on whether the dwindling supplies of large old redwood timber in Del Norte and Humboldt Counties should be converted to products or preserved in Parks. But for those who are concerned with the long-term economic welfare of the region and its people and long-term production of wood products for national markets, the focus must be broadened to consider the outlook for timber of all types in the entire North Coast. This study is intended to contribute to that broader focus.

This study addresses several questions about the future output of timber in the North Coast region of California, which includes Del Norte, Humboldt, Mendocino, and Sonoma Counties. More specifically, it is concerned with the prospects for output of softwood sawtimber from private lands of the North Coast over the next 25 years. The four counties were grouped as a logical regional unit because they have similar natural resources, common markets for their forest products, interconnected economies, and a common transportation system. Softwood sawtimber has been selected for study because it is the raw material that now supports the timber economy, a situation not likely to rapidly change. The emphasis on output from private lands recognizes that, (1) private owners control 75 percent of the commercial forest area, from which comes over 80 percent of the region's timber output, and (2) output from public lands is based upon planned allowable harvests which generally are not subject to rapid change. The 25-year study period was selected to span the transition period from old to young timber stands, yet not to exceed the abilities of available techniques and data to project timber stands.

The outlook for timber output in the North Coast may concern a number of audiences at this time. Among these are Congress, which is considering Park expansion, and the State legislature and local governmental units, which are contemplating the impacts of the new timber yield tax. Local governmental units are also concerned with employment aspects of future timber output. The California Department of Forestry, responsible for administering the Forest Practices Act and providing planting stock for harvested lands, needs information that will help determine the future demands on its organization. Public land management agencies in the region can benefit by an awareness of trends in the private sector which will in part determine demands on public resources. And the forest industries need to know of future timber output prospects, so that they can make informed decisions regarding resource use and investments.

The following questions are addressed in this study:

1. What is the current softwood sawtimber inventory in the North Coast, and what are its characteristics?
2. At what rate is it being harvested?
3. Given continuation of current rates and patterns of harvest, how long can current output levels be maintained?
4. Can a change in patterns of use result in maintenance of current output levels for 25 years?
5. What level of output can be maintained for 25 years or longer?
6. What future level of wood input to the region can be expected from public lands?

This study of necessity treats timber outlook prospects for aggregates of all owners within broad owner classes in the North Coast. The aggregate forest conditions and prospective future outputs are indicative of the overall situation in the region. They are not indicative, however, of the timber resource situation on the forest lands of any individual forest land owner.

# PROCEDURES

To meet the objectives identified for this study, it was necessary to undertake a number of steps in preparation for the analysis of future outlooks. Those steps are summarized here and amplified as necessary in the following pages. First, the existing timber inventory data had to be restructured to make it descriptive of discrete stands and to facilitate development of growth predictions and adjustments for harvesting. The second step was to develop growth predictions needed to update the inventory and project it into the future. Then actual harvest since inventory had to be determined. The next step was to update the inventory to provide an estimate of the current resource base. The final step was to investigate the impacts of several alternative future output levels on the resource base in order to determine potential timber output prospects for the region, and for some political, ownership, and resource subunits thereof. Readers not interested in the detailed procedures can save time by turning to the discussion of future output alternatives on page 10.

## THE FOREST INVENTORY DATA BASE

The timber inventories of North Coast counties were conducted in the 1960's (Oswald and Walton 1966, Oswald 1968, Oswald 1972). As part of the inventories, timber stand attributes were collected on 629 1-acre field plots. These field plots are the source of basic resource data used in this study.

Before classifying the inventory data into discrete stands for use in this study, the method of stand growth prediction had to be selected. After careful study of the resource data for the Region, the yield table approach was discarded. Due to the condition and complexity of the stands, existing yield tables were descriptive of a very small proportion of the stands. The stand table projection method was selected to project growth and development of the region's timber stands.

The next step was development of stand descriptions broad enough to make the use of stand table projections feasible, yet descriptive of the condition and merchantability of the stands. Species types, stand size, stand density, and site class were selected as key variables for use in defining the timber classes. Since this study is concerned with species and size of merchantable trees, a system of stand (plot) classification was devised that favored softwoods over hardwoods, and basal area-sized trees (5.0-inches + d.b.h.) over seedlings and saplings. This was to insure that the maximum number of acres with merchantable material be identified in the classification process.

Following is a summary of the major criteria used in classifying the plots:

1. A stand needs only 10-percent conifer stocking to be a conifer stand, regardless of of hardwood stocking.
2. A stand needs only one-third of stocked area in basal area-sized trees (5.0-inches + d.b.h.) to be classed as poletimber or sawtimber stand.
3. Conifer poletimber and sawtimber stands are placed into five basal area classes, based upon all live conifer trees.
4. Conifer stands are classed as redwood or other conifer, based on predominance of stocking.
5. Areas are classed as high or low site, based upon potential to produce wood. Those with mean annual increment potential of 120 cubic feet per acre/year or more are high site; if not, low site.
6. Seedling-sapling stands are placed into one of two stocking classes; $\geq 70$ percent of area stocked; and $< 70$ percent of area stocked.

The combination of stand variables yielded 71 potential classes or stand descriptions. Each of the 629 plots from the North Coast inventories was placed in its appropriate class. Many classes contained no plots or too few to provide adequate tree data for prediction of growth and development of other average stand parameters. It was therefore necessary to collapse some classes into others. In most cases, stand sizes were combined; in a few instances site classes were combined. Neither species nor basal area classes were combined in the process. The process of combination yielded 31 stand classes. Table 2 provides a list of these final classes, with brief descriptive features of each.

Stand classes 1 through 22 include 850,000 acres of private forest land classed as having potential for timber production, but whose condition or stage of stand development in 1967 makes it unlikely that they will produce harvestable sawtimber before year 2000. Of this area, 703,000 acres (classes 1 through 6) were either not stocked with trees or were stocked with hardwoods rather than conifers in 1967. Even if some of this area was restocked with conifer seedlings in the last 10 years, it

Table 2--*Summary of timber class descriptions North Coast region, California*

| Timber class | Type | Site[1] | Stand size | Stocking level[2] |
|---|---|---|---|---|
| 1 | nonstocked | low | -- | -- |
| 2 | nonstocked | high | -- | -- |
| 3 | hardwood | low | seedling-sapling | [3] |
| 4 | hardwood | high | seedling-sapling | [3] |
| 5 | hardwood | low | poletimber or larger | [3] |
| 6 | hardwood | high | poletimber or larger | [3] |
| 13 | redwood | high | seedling-sapling | <70% |
| 14 | redwood | high | seedling-sapling | ≥70% |
| 19 | other conifer | low | seedling-sapling | <70% |
| 21 | other conifer | high | seedling-sapling | <70% |
| 22 | other conifer | high | seedling-sapling | ≥70% |
| 43 | redwood | high | sm. sawtimber | <50 |
| 44 | redwood | high | sm. sawtimber | 50-100 |
| 45 | redwood | high | sm. sawtimber | 100-200 |
| 46 | redwood | high | sm. sawtimber | 200-300 |
| 47 | other conifer | low | sm. sawtimber | <50 |
| 48 | other conifer | low | sm. sawtimber | 50-100 |
| 55 | redwood | low | lg. sawtimber | <50 |
| 56 | redwood | low | lg. sawtimber | 50-100 |
| 59 | redwood | high | lg. sawtimber | <50 |
| 60 | redwood | high | lg. sawtimber | 50-100 |
| 61 | redwood | high | lg. sawtimber | 100-200 |
| 62 | redwood | high | lg. sawtimber | 200-300 |
| 63 | other conifer | low | lg. sawtimber | <50 |
| 64 | other conifer | low | lg. sawtimber | 50-100 |
| 65 | other conifer | low | lg. sawtimber | 100-200 |
| 67 | other conifer | high | lg. sawtimber | <50 |
| 68 | other conifer | high | lg. sawtimber | 50-100 |
| 69 | other conifer | high | lg. sawtimber | 100-200 |
| 70 | other conifer | high | lg. sawtimber | 200+ |
| 71 | redwood | high | lg. sawtimber | 300+ |

[1] Site class is based upon potential yield, cubic feet per acre mean annual growth, at culmination of increment in fully stocked stands. Low site is 20-119 cubic feet, high site ≥120 cubic feet.

[2] Percent of area stocked with conifers for seedling-sapling stands, square feet basal area of all conifers 5.0 inches + d.b.h. for sawtimber stands.

[3] Stocking levels were not specified for hardwood stands.

could not produce 40-year-old softwood sawtimber until about 2010.

About 115,000 acres (classes 13, 19, 21) were partially stocked with conifer regeneration in 1967. Although over half of this area is low site, some of the higher site lands might produce harvestable sawtimber stands by year 2000, or shortly thereafter.

The 32,000 acres in classes 14 and 22 were high site lands well stocked with regeneration in 1967. Some of this area will likely produce well stocked stands of sawtimber of merchantable size by year 2000 or shortly thereafter.

In this study, no sawtimber yield is assumed for any of this area (850,000 acres), because it is likely that at most only a few thousand acres have the potential to produce usable output before year 2000. Much of this area is unlikely to contribute softwood sawtimber output even beyond the turn of the century, due to current condition and small potential for remedial treatment.

Stand classes 43 through 71 are termed sawtimber classes because they contain timber considered available for harvest immediately or in the near future. These classes are broadly defined and include a number of stand conditions. Included are some areas that could be classed as seedling-sapling stands; but they had sufficient conifer trees of pole or sawtimber size to warrant inclusion as sawtimber stands, on the basis that the merchantable elements of the stand will be of more value in the near term than the regeneration. The sawtimber classes include all of the region's coniferous poletimber stands. Also included are the stands of residual timber and scattered seed trees.

Stand classes 43 through 48 are young stands of small sawtimber (<21-inch d.b.h.) and poletimber. Stand classes 55 through 71 are large sawtimber and include large young sawtimber, old sawtimber, mixed stands of young and old timber, and residual and seed tree stands. The sawtimber stands characterized by low basal area contain most of the region's acreage of seed tree and sparse residual timber stands.

A few points about the stand classes need clarification. The stand class numbers are a discontinuous sequence because they are the surviving classes from the original classification. "Type" and "stand size" in this classification are not comparable to forest type and stand size as defined and displayed in the inventory reports cited earlier. They were developed solely for this study. Stand size and stocking information are either less detailed or not specified for hardwood stands because this study makes no use of those stands, other than identifying them. It is assumed that those stands and the seedling-sapling stands will contribute little, if any, to softwood sawtimber for the period selected for this study.

Table 3 shows the number of field plots, the expanded acres they represent, and the mean per acre stand values of basal area, volume, and net annual growth for the stand classes developed for use in this study. The areas have been adjusted for area losses and increments associated with establishment of the Redwood National Park. The per-acre stand values are weighted mean values developed from the plots[1] that were assigned to each class. The areas, stand descriptions, and average stand parameters describe the North Coast region's commercial forest resource as it existed at the time of the inventories (approximately 1967), except for the acreage adjustment for the Redwood National Park (which was established in 1968).

Several of the nonstocked and seedling sapling classes (1, 13, 14, 22) have very few plots, which is not desirable for developing mean values. The mean values for conifer growth, volume, and basal area for any of the nonstocked, hardwood, or seedling-sapling stands (classes 1-22) have little use. They are shown merely to emphasize the lack of merchantable softwood sawtimber in those types of stands.

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[1] The mean per acre values are based upon 573 plots in Humboldt, Mendocino, and Sonoma Counties. The 56 Del Norte County plots were not used in developing the mean values due to differences in plot design. They were however placed in stand classes, and are included in stand class acreages.

Table 3--*Selected mean stand parameters, by timber class, North Coast Region, California, 1967*

| Timber class | Number of field plots[1] | Expanded acres[2] | Mean stand values, per acre | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Basal area[3] | | Growing-stock volume | | Sawtimber volume | Growing-stock growth | | Net sawtimber growth |
| | | | Softwoods | Hardwoods | Softwoods | Hardwoods | Softwoods | Softwoods | Hardwoods | Softwoods |
| | | | Square feet | | ---- Cubic feet[4] ----- | | Board feet[5] | ---- Cubic feet[4] ----- | | Board feet[5] |
| 1 | 5 | 28,334 | 5 | 3 | 130 | 0 | 343 | 7 | 0 | 15 |
| 2 | 7 | 43,488 | 3 | 1 | 63 | 0 | 285 | 0 | 0 | 0 |
| 3 | 25 | 126,916 | 3 | 20 | 90 | 194 | 378 | 1 | 7 | 9 |
| 4 | 22 | 117,630 | 5 | 24 | 165 | 329 | 788 | 7 | 12 | 24 |
| 5 | 60 | 258,206 | 5 | 80 | 119 | 789 | 517 | 0 | 22 | 0 |
| 6 | 23 | 128,108 | 10 | 98 | 289 | 1,643 | 1,588 | 5 | 44 | 44 |
| 13 | 2 | 9,611 | 20 | 12 | 236 | 153 | 434 | 23 | 4 | 31 |
| 14 | 2 | 9,875 | 12 | 4 | 303 | 55 | 1,310 | 11 | 4 | 51 |
| 19 | 12 | 60,186 | 3 | 51 | 87 | 551 | 482 | 0 | 12 | 0 |
| 21 | 10 | 45,383 | 3 | 27 | 53 | 313 | 184 | 12 | 16 | 7 |
| 22 | 3 | 22,130 | 13 | 0 | 356 | 0 | 1,610 | 11 | 0 | 59 |
| 43 | 11 | 57,377 | 34 | 18 | 593 | 199 | 1,891 | 37 | 7 | 105 |
| 44 | 13 | 72,608 | 74 | 19 | 1,506 | 182 | 5,097 | 78 | 12 | 302 |
| 45 | 20 | 99,644 | 148 | 43 | 3,489 | 460 | 13,325 | 156 | 31 | 684 |
| 46 | 15 | 67,301 | 235 | 28 | 5,475 | 199 | 22,395 | 220 | 16 | 1,051 |
| 47 | 34 | 162,554 | 31 | 52 | 815 | 498 | 2,493 | 29 | 18 | 111 |
| 48 | 16 | 79,473 | 75 | 43 | 2,053 | 458 | 7,480 | 62 | 13 | 275 |
| 55 | 9 | 43,081 | 28 | 45 | 808 | 497 | 3,515 | 13 | 28 | 52 |
| 56 | 18 | 89,192 | 71 | 45 | 1,878 | 448 | 7,991 | 35 | 12 | 144 |
| 59 | 17 | 95,861 | 36 | 21 | 1,109 | 254 | 5,153 | 28 | 9 | 131 |
| 60 | 15 | 66,309 | 73 | 22 | 1,811 | 214 | 7,779 | 52 | 16 | 217 |
| 61 | 29 | 157,314 | 144 | 40 | 4,180 | 436 | 19,485 | 91 | 13 | 403 |
| 62 | 26 | 117,998 | 248 | 37 | 7,652 | 342 | 37,767 | 104 | 14 | 495 |
| 63 | 43 | 199,481 | 32 | 53 | 844 | 478 | 4,344 | 15 | 12 | 86 |
| 64 | 29 | 109,444 | 75 | 83 | 2,346 | 885 | 12,531 | 43 | 23 | 187 |
| 65 | 15 | 74,308 | 125 | 56 | 3,576 | 649 | 16,834 | 67 | 19 | 327 |
| 67 | 20 | 98,501 | 28 | 35 | 897 | 329 | 4,959 | 17 | 1 | 92 |
| 68 | 13 | 49,714 | 76 | 71 | 2,459 | 801 | 13,943 | 44 | 25 | 207 |
| 69 | 18 | 80,310 | 142 | 49 | 4,302 | 625 | 22,603 | 60 | 12 | 386 |
| 70 | 19 | 76,534 | 267 | 34 | 8,401 | 399 | 49,322 | 104 | 10 | 650 |
| 71 | 22 | 132,888 | 432 | 19 | 13,531 | 185 | 69,461 | 157 | 6 | 757 |
| All classes | 573 | 2,779,759 | | | | | | | | |

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[1] Due to plot design and lack of growth data for Del Norte plots, mean stand values were developed from 573 plots in Mendocino, Humboldt, and Sonoma Counties.

[2] Area estimates include all private commercial forest lands in Humboldt, Del Norte, Mendocino, and Sonoma Counties.

[3] All live trees ≥5.0-inches d.b.h.

[4] Growing-stock trees ≥5.0 inches, to a 4.0-inch top, 0.8.

[5] Scribner rule. Trees ≥11.0 inches to a utilized top.

## *PREDICTIONS OF STAND GROWTH*

The inventories of the North Coast counties, as published or as restructured herein, give an impression of the resource at a time in the past. But that resource is changing continuously through the natural processes of growth and mortality and through activities such as timber harvesting. If the North Coast inventories are to be useful in determining alternative future outputs, they must be updated to a current base date; and there must be a mechanism for projecting them into the future. For national and regional studies of timber conditions and supplies, the Forest Service has developed and used a model called TRAS (Timber Resource Analysis System) (Larson and Goforth 1970, 1974). The model, based upon the stand table projection method of growth prediction, has usually been applied by treating large areas as a single problem. This approach has merit for broad regional or national studies where the results are grouped over large areas, where detailed input parameters for smaller areas are lacking, or where there is no need to know how small parts of the total resource are changing with time.

In the North Coast region, there is a need for better understanding of how components of the total resource have changed and are likely to change in the future. The stands vary as to species, timber size, volume concentration, and growth potential. These are important differences to land managers, mill operators, and end product markets. The stand classification presented in the previous section is an attempt to recognize these important differences and to provide the basis for a detailed approach for updating and projecting the region's timber resource.

For this study, the TRAS program was used for updating and projecting each of the stand classes of sawtimber size (classes 43-71). Since the objectives of the study center on softwood sawtimber availability over the next 25 years, no attempt was made to update or project other stand classes (classes 1-22).

For each sawtimber class, inputs for the TRAS model were developed from stand and tree data taken from the plots in that class. The inputs include number of growing stock conifers by 2-inch diameter class, radial growth and tree mortality rates by diameter class, and total volume, growth, and live tree basal area. All inputs were mean values derived from the plots.

An average acre was developed based upon the mean values of all combined plots in each class. For each sawtimber stand class, the average acre was moved ahead to January 1975 to provide an updated statement of the inventory of each stand, and then projected to the year 2020.

Key assumptions used in making the projections were:

(1) Stands with high basal area (all trees) would experience increased mortality and decreased tree radial growth with increases in basal area. Such "growth constraints" were applied to classes 45, 46, 61, 62, 64, 65, 68, 69, 70, and 71.

(2) In stands with high basal area, ingrowth into the 2-inch diameter class would not effectively add to the stand. No ingrowth into the 2-inch diameter class was used in projecting growth and stand development in those classes listed in (1), above.

(3) Total softwood sawtimber volume in each stand was included as sawtimber yield. No deduction was made for logging residue; it was included as yield to approximate the output from noninventory sources (dead and cull trees).

Softwood sawtimber volume (Scribner rule) on a per-acre basis was projected from 1967 to 2020 for each sawtimber class. The yields are shown in table 4 for 1967 and at 5-year intervals from 1975 through year 2000. The projections for years beyond 2000 are not shown because with one exception they were not used in this study and because of the uncertainties of growth predictions of such long duration. The reader is reminded that these growth predictions were developed as a necessary step in this study. They apply only to the unique "average" stands from which they were developed, those characterized herein as existing in the North Coast region in 1967.

Table 4--*Softwood sawtimber yield per acre by timber class and year, North Coast region, California*

(Board feet, Scribner rule)

| Timber class | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1967 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
| 43 | 1,891 | 2,959 | 4,012 | 5,502 | 7,525 | 10,145 | 13,393 |
| 44 | 5,097 | 7,872 | 10,075 | 12,724 | 15,913 | 19,756 | 24,378 |
| 45 | 13,325 | 18,990 | 22,667 | 26,357 | 29,995 | 33,545 | 36,985 |
| 46 | 22,395 | 30,847 | 36,064 | 41,143 | 46,045 | 50,764 | 55,317 |
| 47 | 2,493 | 3,500 | 4,271 | 5,164 | 6,184 | 7,342 | 8,647 |
| 48 | 7,480 | 9,891 | 11,695 | 13,750 | 16,055 | 18,619 | 21,458 |
| 55 | 3,515 | 3,928 | 4,187 | 4,502 | 4,834 | 5,171 | 5,535 |
| 56 | 7,991 | 9,230 | 10,112 | 11,095 | 12,195 | 13,422 | 14,782 |
| 59 | 5,153 | 6,339 | 7,225 | 8,196 | 9,307 | 10,623 | 12,244 |
| 60 | 7,779 | 9,728 | 11,243 | 13,050 | 15,193 | 17,714 | 20,647 |
| 61 | 19,485 | 22,851 | 25,131 | 27,477 | 29,873 | 32,299 | 34,721 |
| 62 | 37,767 | 41,783 | 44,341 | 46,919 | 49,505 | 52,089 | 54,666 |
| 63 | 4,344 | 5,068 | 5,569 | 6,123 | 6,711 | 7,345 | 8,023 |
| 64 | 12,531 | 14,127 | 15,229 | 16,400 | 17,629 | 18,899 | 20,195 |
| 65 | 16,834 | 19,583 | 21,436 | 23,364 | 25,341 | 27,340 | 29,337 |
| 67 | 4,959 | 5,746 | 6,295 | 6,924 | 7,692 | 8,653 | 9,851 |
| 68 | 13,943 | 15,678 | 16,863 | 18,124 | 19,448 | 20,816 | 22,206 |
| 69 | 22,603 | 25,647 | 27,469 | 29,252 | 31,006 | 32,801 | 34,553 |
| 70 | 49,322 | 54,525 | 57,754 | 60,940 | 64,067 | 67,125 | 70,111 |
| 71 | 69,461 | 75,546 | 79,369 | 83,493 | 87,702 | 91,679 | 95,777 |

## *DEVELOPMENT OF SAWTIMBER HARVEST INFORMATION*

In order to update the sawtimber inventories to 1975 (the date selected as a base date), it was necessary to account for the impacts of harvest in addition to those of growth. Generally available information on harvest by county, such as published annually by the State of California (California Division of Forestry 1967-76), are of little use in updating an inventory detailed by individual stands. For this study it was necessary to detail the impact of harvest on the acres represented by each sawtimber stand class.

The approach used was to visit the county assessor's office in each of the four counties and, using current aerial photos or mapped or otherwise recorded harvest information, identify (on a plot-by-plot basis) those field plots that had been harvested since inventory. Since the process was time consuming, steps were taken to minimize the effort:

(1) No plots were checked in nonstocked, hardwood, or seedling-sapling classes (classes 1-22).

(2) No plots were checked in the sawtimber classes with less than 50 square feet of conifer basal area (classes 43, 47, 55, 59, 63, 67).

(3) In sawtimber classes with 50-100 square feet of conifer basal area (classes 44, 48, 56, 60, 64, 68), only plots with 10,000 board feet or more of softwood sawtimber were checked.

(4) In sawtimber classes with more than 100 square feet of conifer basal area (classes 45, 46, 61, 62, 65, 69, 70, 71), all plots were checked.

In all, 206 privately owned plots, about one third of the region's total, were checked. These plots accounted for over 85 percent of the private sawtimber inventory in 1967. The exclusion of sawtimber plots with less than 10,000 board feet in the 50- to 100-square foot basal area classes, and all plots in the <50 square foot basal area classes was arbitrary. It was done on the assumption that very little of the area with low volume would be cut, and that even those areas cut but overlooked would not significantly contribute to total harvest due to low per acre volumes.

Table 5 presents estimates by class of acres harvested from time of inventory through 1974. These data are needed to update the acreage in each stand class so that an updated inventory can be determined. They also make possible estimation of an average annual harvest for the privately owned forests, and they provide one necessary ingredient for evaluating the future impacts of continuation of current rates and patterns of harvest.

Table 5--*Area of privately owned forest land harvested by timber class, 1967-74, North Coast California*

| Timber class | Area |
|---|---|
| 43[1] | -- |
| 44 | -- |
| 45 | -- |
| 46 | 4,625 |
| 47[1] | -- |
| 48 | -- |
| 55[1] | -- |
| 56 | -- |
| 59[1] | -- |
| 60 | 3,233 |
| 61 | 51,444 |
| 62 | 45,876 |
| 63[1] | -- |
| 64 | 16,989 |
| 65 | 45,083 |
| 67[1] | -- |
| 68 | 9,280 |
| 69 | 14,896 |
| 70 | 33,922 |
| 71 | 72,325 |
| All classes | 297,673 |

[1] It was assumed that no harvest took place in these classes, due to low basal area and volume.

Before the harvest data were used to update the inventory, they were checked for reasonableness. If we assume (1) an 8-year harvest period with harvest distributed by timber classes as shown in table 5, (2) an average volume per acre derived by summing the 1967 and 1975 volume per acre (table 4) and dividing by 2, and (3) that each acre cut had all of its softwood sawtimber harvested, the average annual harvest from private lands is estimated to be 1,452 million board feet. For the same period, the California Division of Forestry harvest reports, revised to exclude harvests from public lands and non-inventory sources, indicate an average annual sawtimber harvest of 1,494 million board feet.

| Year | All counties | Humboldt-Del Norte | Mendocino-Sonoma |
|---|---|---|---|
| | - - - - - - | (MMBF) | - - - - - - |
| 1967 | 1,554 | 1,104 | 450 |
| 1968 | 1,648 | 1,137 | 511 |
| 1969 | 1,582 | 1,096 | 486 |
| 1970 | 1,343 | 919 | 424 |
| 1971 | 1,381 | 935 | 446 |
| 1972 | 1,493 | 1,003 | 490 |
| 1973 | 1,516 | 1,022 | 494 |
| 1974 | 1,433 | 950 | 483 |

The acres harvested since inventory constitute an additional class of timberland which can best be characterized as "acres cut" since inventory. This class, totaling 298,000 acres, is an area about which little is known. The ownership and site class are known, for they don't change with harvest. But amount of residual volume (if any), stocking level, and other detailed information can only come from inspection on the ground. For this study they are treated as cutover acres that will not contribute significant sawtimber volume over the next 25 years.[2]

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[2] In Humboldt and Del Norte Counties, most of the acres cut were "clearcut," or "seed tree" cuts, in which only a few sawtimber conifers were left standing. In Mendocino-Sonoma, there was also much clearcutting and seed tree cutting. On a substantial area in these two counties, however, selective harvest of conifers has left substantial volumes of residual timber. This residual volume, on areas cut from 1967 to 1974, is "lost" in this study; however, residual volume on acres harvested prior to 1967 is in the study.

But in the longer term, those cutover acres and the acres that will be harvested in the years to come will become vitally important.

## THE NORTH COAST REGION'S PRIVATE SAWTIMBER RESOURCES, 1975

The recent years of growth and harvest in the North Coast's privately owned timber stands have substantially altered this resource. Acreage in sawtimber (classes 43-71) declined 15 percent from 1967 to 1975.

Softwood sawtimber inventory decreased about 7 billion board feet or 21 percent, due to sawtimber harvest in excess of growth.[3] Volume increases attributable to growth offset 4.6 of the 11.6 billion board feet of harvest on private lands during the period.

Tables 5 and 6 show some patterns of resource use that will have consequences for future outputs in the North Coast Region. Although 10 of the 20 sawtimber classes have been partially harvested during the 8-year period, the impacts have fallen primarily on five classes (61, 62, 65, 70, 71). Predictably, those classes experiencing heavy use were the high volume/large sawtimber classes. One class in particular has carried a huge share of the harvest. Class 71, the redwood class with the highest per-acre basal area and volume, accounted for 45 percent of the total private harvest; both volume and area in this class have declined over 50 percent.

Twelve of the 20 classes, including 2 that have experienced minor amounts of harvest, show considerable increases in inventory volume, reflecting sawtimber growth in those classes. The remainder of classes have experienced volume decreases due to acres and volume harvested in excess of the growth increases on the acres remaining (uncut) in each of these classes.

Table 6--*Area and volume of privately owned sawtimber stands, by timber class, 1967 and 1975, North Coast region, California*

| Timber class | Private | | | |
|---|---|---|---|---|
| | 1967 | | 1975 | |
| | Area[1] | Volume[2] | Area[1] | Volume[2] |
| 43 | 57,377 | 108.5 | 57,377 | 169.8 |
| 44 | 72,608 | 370.1 | 72,608 | 571.6 |
| 45 | 99,644 | 1,327.8 | 99,644 | 1,892.2 |
| 46 | 67,301 | 1,507.2 | 62,676 | 1,933.4 |
| 47 | 162,554 | 405.2 | 162,554 | 568.9 |
| 48 | 79,473 | 594.5 | 79,473 | 786.1 |
| 55 | 43,081 | 151.4 | 43,081 | 169.2 |
| 56 | 89,192 | 712.7 | 89,192 | 823.2 |
| 59 | 95,861 | 494.0 | 95,861 | 607.7 |
| 60 | 66,309 | 515.8 | 63,076 | 613.6 |
| 61 | 157,314 | 3,065.3 | 105,870 | 2,419.2 |
| 62 | 117,998 | 4,456.4 | 72,122 | 3,013.5 |
| 63 | 199,481 | 866.5 | 199,481 | 1,011.0 |
| 64 | 109,444 | 1,371.4 | 92,455 | 1,306.1 |
| 65 | 74,308 | 1,250.9 | 29,225 | 572.3 |
| 67 | 98,501 | 488.5 | 98,501 | 566.0 |
| 68 | 49,714 | 693.2 | 40,434 | 633.9 |
| 69 | 80,310 | 1,815.2 | 65,414 | 1,677.7 |
| 70 | 76,534 | 3,774.8 | 42,612 | 2,323.4 |
| 71 | 132,888 | 9,230.5 | 60,563 | 4,575.3 |
| Total | 1,929,892 | 33,199.9 | 1,632,219 | 26,234.1 |

[1] Acres.

[2] Million board feet, Scribner rule.

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[3] The nonsawtimber stands (classes 1-22), which accounted for less than 2 percent of sawtimber volume and growth in 1967, were not updated and are not included in these data.

It should be noted that the data for this study came from several inventories. These data have been combined and updated. No estimates of precision can be made for these modified data. Those interested in statistical precision of the inventories used in this study should refer to Oswald and Walton 1966; Oswald 1968, and Oswald 1972.

## *SOFTWOOD SAWTIMBER OUTPUT ALTERNATIVES FROM PRIVATE LANDS IN THE NORTH COAST REGION*

What is the outlook for timber output from the private lands that have historically provided most of the region's timber? This question can best be answered by identifying and answering several more specific questions.

### *SCENARIO I*[4]

The present timber economy is using types and quantities of timber that meet the needs of the existing facilities and the markets for which they produce. Can the region's private softwood sawtimber resource continue to meet these needs by sustaining the current patterns and rates of harvest for some time in the future? Patterns refer here to groups of timber classes, and rates to acres (and volumes) harvested by timber class. The time period selected for analysis, as was mentioned earlier, is 25 years. This question might be termed the recent trends scenario. If the 10 classes that have been providing the harvest are harvested at their historical acreage rates, they will provide outputs over the next 25 years as follows:[5]

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Number of classes harvested | 10 | 9 | 7 | 6 | 5 | 5 |
| Sawtimber harvest (MMBF) | 1,529 | 1,507 | 585 | 342 | 162 | 173 |

Of the total 1975 harvest, 1,410 million board feet (92 percent) comes from five large, high volume classes (61, 62, 65, 70, 71).[6] With current use rates, class 65 will be exhausted in 1979; in 1981, class 71, which has been providing 45 percent of all output from private lands, will be exhausted, followed by class 70 in 1984, and classes 61 and 62 in 1990. The five other classes can produce well into the next century at current acreage depletion rates but will yield less than 200 million board feet per year at those rates.

What can be learned from this scenario? One conclusion easily drawn is that the types of forest stands that have been supporting the region's private harvest will soon be exhausted under current rates of use. A shift in harvest from acres with high volume concentrations in large trees to acres with lower volumes and smaller trees will be required if output of timber from the private sector is to be maintained in the years to come.

The first scenario is unlikely to occur. The timber-based industries have historically responded to declining availability of one timber resource by adjusting to others. In the North Coast region, it is likely that smaller sawtimber in lower volume per acre concentrations will be used increasingly as high volume stands become more scarce. The following discussion will explore some possible alternatives to Scenario 1.

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[4] To facilitate identification the questions in the following pages will be identified and referred to as numbered scenarios.

[5] The process used to investigate the future prospects for sawtimber output from private lands in the North Coast region is the same one used to update the inventory. The yields (table 4) and the 1975 acres by timber class (table 6) are the basic ingredients. The acres harvested by class (table 5) and the annual harvest rates implied (acres harvested per year) are also used. The process is simply a bookkeeping approach, consisting of selecting patterns (by class) and rates of harvest, or patterns and total desired amounts of harvest. The product of acres x volume for all harvested classes provides the estimate of total output. All acres are assumed to be clearcut, and the net softwood sawtimber inventory volume on each is assumed to be output.

[6] These classes correspond to the class names shown in the tables presented earlier. Tables 2, 3, and 4 should be consulted if a description of classes is needed.

Two major assumptions were employed in investigating specific questions about the ability of the sawtimber resource to sustain recent harvest levels by departing from recent patterns and rates of harvest. They are: (1) harvest rate. In some instances the historic harvest rates for the (five) heavily harvested classes are used; in other instances a specific period (10 years) is used for depletion. For all other classes, a 10-year depletion schedule is used--that is, one-tenth of the acreage in each class is harvested each year; (2) stand availability. No stands are considered available until they have at least 5,000 board feet of softwood sawtimber. Under this assumption, 17 of 20 sawtimber classes are available in 1975, 19 in 1985, and 20 in 1995. This assumption has essentially no limiting effect on any of the scenarios in which it is used.

## *SCENARIO II*

If the five high use classes are used at their historic harvest rate and other classes are used on the basis of highest volume classes[7] first, how long can recent output levels be maintained?

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Sawtimber output (MMBF) | 1,500 | 1,500 | 1,481 | 1,433 | 532 | 24 |
| Acres harvested | 33,965 | 28,828 | 71,507 | 115,064 | 65,685 | 4,308 |

This scenario indicates that, if classes with high historic use patterns are augmented by other stands on a high volume first basis in order to maintain output, harvest can be maintained at recent levels until 1989. From 1990 to 1994, harvest will drop slightly; and by 1995, only low volume sawtimber stands will be available and harvest will drop to one-third of current levels. Another significant feature of this scenario is that by 1990, a 240-percent increase in harvested acreage will be required in order to maintain the output, a reflection of the low per-acre volumes on the acres prospectively available at that time.

## *SCENARIO III*

If the five high use classes are harvested over 10 years instead of at historic rates, and output from them is augmented by other classes on a high volume first basis, the output pattern will be somewhat different.

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Sawtimber output (MMBF) | 1,483 | 1,489 | 1,481 | 1,524 | 141 | 164 |
| Acres harvested | 37,306 | 34,172 | 108,484 | 105,350 | 20,563 | 20,563 |

The primary difference between this and Scenario II occurs in 1990 and 1995, when, due to differences in scheduling of classes, more output is in prospect in Scenario III in 1990, less in 1995. Otherwise the prospects for output are similar to those of Scenario II.

## *SCENARIO IV*

Another approach to harvest scheduling is investigated because theoretically it can maximize the output potential over time. This approach might be termed the "protect growth" scenario. In this scenario the stands with the lowest growth percent are harvested first, thus protecting those stands that have the most efficient (highest) growth percent.[8] Each class is harvested over a 10-year period. In terms of output over time this scenario is almost identical to the previous scenario.

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Sawtimber harvest (MMBF) | 1,511 | 1,498 | 1,458 | 1,507 | 223 | 278 |
| Acres harvested | 50,983 | 31,035 | 113,216 | 93,268 | 17,307 | 17,307 |

The similarity occurs because the historic harvest pattern, the high volume pattern, and the low growth percent pattern order the stands for harvesting in a similar way. In other words, the recent historical cutting pattern tends to maximize the output per acre harvested and defers harvest of those stands that are most efficient in terms of growth percent. From the standpoint of maintaining output of sawtimber, there is little to choose from between the high volume and the low growth percent harvest approaches. They select essentially the same stands in the first decade; and because of heavy demands made upon remaining stands, almost all of the available stands are harvested in the second decade.

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[7] When harvest priorities were based upon volume, the ordering of stand classes was based upon mean volume, 1975-2000, determined by summing 1975 and 2000 values and dividing by 2.

[8] Growth percent is the ratio of sawtimber growth to sawtimber volume.

All of the scenarios discussed to this point are similar in one important aspect. They all indicate that recent levels of sawtimber output from the North Coast region's important private sector cannot be maintained for more than 15 to 20 years. If they are maintained for that period by rapid harvest of young stands, a large falldown in output must almost certainly follow. There will not be enough sawtimber reserves to support output into the early years of the next century, at which time stands established in recent years will be of merchantable size.

As older stands are harvested, logging operations are moving into younger stands which will eventually provide most of the Region's output. But recent levels of output cannot be maintained by available young sawtimber stocks, and attempts to do so will rapidly deplete the young timber resource and result in precipitous declines in output.

As an alternative to high outputs for 15 to 20 years followed by abrupt falldowns, the Region's forest enterprises could follow a course that would allow higher future outputs. Such a course would involve near-term downward adjustments in sawtimber output, which would allow more sawtimber stocks to be carried for future use. Those stocks could bridge the potential gap between availability of existing sawtimber stands and availability of stands only now being established.

## *SCENARIO V*

There are many potential profiles of harvest that might bridge the gap; one was developed in this study. For this scenario, low growth percent stand classes were harvested first, and stand classes were harvested on a 10-year schedule. The goal was to stretch output from the existing private sawtimber resource over a 40-year period, utilizing a rapid transition to a level that could be sustained through year 2015. This was achieved by assuming an immediate 20-percent decrease in output, followed by decreases in 1980 and 1985, with stable output thereafter.

This scenario indicates that with rather substantial declines starting in 1975, output from sawtimber stands in the private sector could be maintained at about 60 percent of recent levels from 1985 to 2015. This type of alternative has its drawbacks and merits. On the negative side, it would require immediate downward adjustment in output from the private sector, resulting in rather severe impacts on the region's economy. Its merits are that it could forestall an even more severe economic impact in 15 to 20 years and provide a timber resource to carry a scaled down forest enterprise into the next century, at which time stands only now being established might become available for harvest.

As some of the other scenarios have indicated, the time for choosing among alternatives is short. Another 10 years (or even less) of outputs at the 1967-74 levels will foreclose on the region's options to stretch out the use of its private sawtimber resources to 2015.

*SCENARIO V*

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|---|---|
| Sawtimber harvest (MMBF) | 1,216 | 1,047 | 895 | 877 | 857 | 885 | 875 | 917 |
| Acres harvested | 26,902 | 17,529 | 53,196 | 62,592 | 35,001 | 24,179 | 47,357 | 45,148 |

All of the scenarios have in common prospects for declining output of sawtimber in the North Coast region, before the end of this century. But what of the pieces of this complex timber resource puzzle? For all of the scenarios developed and presented, sawtimber resources of different species groups, from different owner groups, in different geographic areas have been treated as interchangeable. In reality, these differences might render some of the timber resources unavailable as substitutes for others. Limitations of the data make it impossible to explore all of the different timber resource characteristics that might bear on output. Three will be explored in the following pages. First, redwood and Douglas-fir stands will be looked at as separate entities. Second, forest industry and miscellaneous private owners will be treated separately. Third, two rather independent subareas of the region, Humboldt-Del Norte and Mendocino-Sonoma will be studied briefly.

A pair of scenarios is developed for each pair of resource characteristics. The harvest priority used in each scenario first treats high volume stands with high-use classes harvested at historic rates, and then other classes harvested in 10 years. The goal for each scenario is maintenance of harvest at recent levels.

## *SCENARIO VI*

The redwood and Douglas-fir (other conifer) stands have different compositions, although each type of stand may have considerable amounts of the other species. The prospects for the stands in either type will give some indication of the output prospects for the namesake species. In this scenario output from redwood stands can be maintained at recent levels until 1989; but by 1995 few sawtimber stands will be left and output will drop below 100 million board feet. Given the assumptions of this scenario, Douglas-fir output can be maintained until 1994, when all available stands will have been harvested. The total output arrived at by summing the two types is similar to some of the other scenarios, though not identical because of the different combinations of classes harvested by decade.

|  | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Redwood output (MMBF) | 1,070 | 1,134 | 1,051 | 741 | 80 | 24 |
| Douglas-fir output (MMBF) | 509 | 425 | 486 | 553 | 0 | 0 |
| Total | 1,579 | 1,559 | 1,537 | 1,294 | 80 | 24 |

## *SCENARIO VII*

The two major subgroups of privately owned forest land in the North Coast Region are forest industry and miscellaneous private. The former category includes forest lands owned by companies operating timber processing plants. The latter owner group includes all other privately owned forest land, including land owned by farmers, speculators and recreationists, and lands managed for timber production by those not operating processing plants. A major differentiation between the two subclasses of private ownership is that the latter group has resources uncommitted to processing facilities and therefore potentially available in the raw material markets. Though not much is known about their availability for timber production, these miscellaneous private lands have, and will continue to provide considerable amounts of raw material for the region's forest industries. For this study all of the miscellaneous private timber stands are considered available. This simplifying assumption probably results in overestimation of output potential for this owner group.

In 1975 forest industry lands included 49 percent of the region's privately owned sawtimber stands and 55 percent of the sawtimber volume (table 7). In recent years, this owner group has accounted for over two-thirds of the private sawtimber output. Recent levels of output, however, cannot be maintained beyond

|  | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Forest industry (MMBF) | 1,060 | 1,036 | 843 | 337 | 9 | 10 |
| Miscellaneous private (MMBF) | 504 | 449 | 444 | 486 | 460 | 511 |
| Total | 1,564 | 1,485 | 1,287 | 823 | 469 | 521 |

Table 7--*Area of privately owned sawtimber stands by timber class and owner, North Coast region, January 1, 1975*

| Sawtimber class | All private | Forest industry | Miscellaneous private |
|---|---|---|---|
| | (Acres) | | |
| 43 | 57,377 | 27,091 | 30,286 |
| 44 | 72,608 | 30,410 | 42,198 |
| 45 | 99,644 | 65,347 | 34,297 |
| 46 | 62,676 | 38,865 | 23,811 |
| 47 | 162,554 | 45,251 | 117,303 |
| 48 | 79,473 | 21,433 | 58,040 |
| 55 | 43,081 | 17,679 | 25,402 |
| 56 | 89,192 | 55,939 | 33,253 |
| 59 | 95,861 | 72,236 | 23,625 |
| 60 | 63,076 | 44,236 | 18,840 |
| 61 | 105,870 | 65,826 | 40,044 |
| 62 | 72,122 | 51,354 | 20,768 |
| 63 | 199,481 | 65,066 | 134,415 |
| 64 | 92,455 | 37,479 | 54,976 |
| 65 | 29,225 | 9,855 | 19,370 |
| 67 | 98,501 | 56,618 | 41,883 |
| 68 | 40,434 | 15,506 | 24,928 |
| 69 | 65,414 | 24,186 | 41,228 |
| 70 | 42,612 | 14,055 | 28,557 |
| 71 | 60,563 | 41,106 | 19,457 |
| Total | 1,632,219 | 799,538 | 832,681 |

1984;, and by the early 1990's few sawtimber stands, and little sawtimber output will be available if recent levels of harvest continue into the mid-1980's.

The miscellaneous private lands have adequate sawtimber stands to maintain recent sawtimber output levels until 2000. Given the likelihood of decreasing output from industry lands, the sawtimber resources of these small private ownerships could be of increasing importance to the region's timber economy during the next 25 years, if they are made available for harvest by their owners.[9]

## SCENARIO VIII

The geographic separation of the region into two areas is potentially the most meaningful of the pairs of scenarios investigated. Humboldt-Del Norte and Mendocino-Sonoma are at different stages of development in their use of timber resources. The latter counties experienced drastic falldowns in output 15 to 20 years ago in what was likely a major adjustment to declining sawtimber reserves. In Humboldt-Del Norte, private output has dropped somewhat since the late 1960's but stabilized in the early 1970's. No major downward adjustment is yet in evidence.[10] These two counties are still largely dependent on the decreasing acres of large sawtimber stands.

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Humboldt-Oel Norte (MMBF) | 1,039 | 826 | 896 | 71 | 66 | 9 |
| Mendocino-Sonoma (MMBF) | 519 | 555 | 583 | 529 | 549 | 527 |
| Total | 1,558 | 1,381 | 1,479 | 600 | 615 | 536 |

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[9] Some forest industrial landowners in the North Coast have an active program directed toward expansion of their forest land and timber base through acquisition of miscellaneous private holdings. Consequently, some of the lands considered "miscellaneous private" or "small private" in this study are probably now owned by forest industrial companies.

[10] The mean private output 1965-69 was 1,246 million board feet; in 1970-75 it was 1,052 million board feet, 84 percent of the late 1960's average, and 94 percent of the average output (1,122 million board feet) for the 1967-74 period.

In 1975, Mendocino-Sonoma had 54 percent of the privately owned sawtimber acreage in the North Coast region, and 53 percent of the sawtimber inventory (table 8). Recent levels of output can be maintained to 2010 or beyond from existing sawtimber stands. In contrast, 82 percent of Humboldt-Del Norte output is being supported by three high-use timber classes that will be gone (at recent rates of use) by 1980. Although these two counties have less than half of the region's privately owned sawtimber volume, they have been producing over two-thirds of the private timber output. Given the assumptions of this scenario, private output in Humboldt-Del Norte will fall 20 percent by 1980; and by 1990, there will be few if any sawtimber stands and little sawtimber volume available for harvest.

This last pair of scenarios is perhaps the most important of all the ones developed for this study. They indicate that the most important timber-producing county in California, Humboldt, and its adjoining neighbor to the north, Del Norte, are on the verge of a major downward adjustment in sawtimber output from the private lands that have provided those counties' timber outputs for 125 years. Mendocino-Sonoma's output is supportable from existing sawtimber inventories. It appears as though Humboldt and Del Norte Counties will very soon be confronted with the economic consequences of substantial dislocations in their major basic industries. The sawtimber outlook in those two counties is responsible for the decline in sawtimber output indicated in the earlier scenarios for the entire region.

Accelerated harvest of Mendocino-Sonoma's sawtimber stands, including young stands, could provide raw material to temporarily postpone regional output declines and provide raw material for some of Humboldt-Del Norte's mills. But such raw material substitution, if it occurs, will merely postpone the eventual declines in regional output, which could then affect Mendocino-Sonoma as well as Humboldt-Del Norte. Scenarios II, III, and IV reflect the regional outcome that could be expected in such a case.

Table 8--*Area of privately owned sawtimber stands, by timber class and county group, North Coast region, January 1, 1975*

| Sawtimber class | All counties | Humboldt-Del Norte | Mendocino-Sonoma |
|---|---|---|---|
| | (Acres) | | |
| 43 | 57,377 | 29,182 | 28,195 |
| 44 | 72,608 | 27,521 | 45,087 |
| 45 | 99,644 | 58,031 | 41,613 |
| 46 | 62,676 | 25,118 | 37,558 |
| 47 | 162,554 | 78,726 | 83,828 |
| 48 | 79,473 | 37,780 | 41,693 |
| 55 | 43,081 | 15,843 | 27,238 |
| 56 | 89,192 | 8,996 | 80,196 |
| 59 | 95,861 | 53,728 | 42,133 |
| 60 | 63,076 | 16,573 | 46,503 |
| 61 | 105,870 | 45,986 | 59,884 |
| 62 | 72,122 | 18,060 | 54,062 |
| 63 | 199,481 | 95,725 | 103,756 |
| 64 | 92,455 | 36,404 | 56,051 |
| 65 | 29,225 | 10,765 | 18,460 |
| 67 | 98,501 | 74,711 | 23,790 |
| 68 | 40,434 | 26,725 | 13,709 |
| 69 | 65,414 | 35,515 | 29,899 |
| 70 | 42,612 | 19,750 | 22,862 |
| 71 | 60,563 | 40,385 | 20,178 |
| Total | 1,632,219 | 755,524 | 876,695 |

### *SCENARIO IX*

Are there alternative output levels for Humboldt-Del Norte that evidence less precipitous declines? The answer, of course, is that there are many potential harvest profiles for the area. One alternative is developed here merely to give an idea of the types of reasonable alternatives that are possible within the context of available sawtimber resources. For this alternative, high-use classes are harvested first, followed by other classes in order of decreasing volume. Each stand is harvested over a 10-year period. The objective in this scenario is a gradual decline in output, to stretch the output from existing stands through year 2000. The Mendocino-Sonoma output is unchanged from the previous scenario.

| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Humboldt-Del Norte (MMBF) | 892 | 653 | 503 | 406 | 385 | 401 |
| Mendocino-Sonoma (MMBF) | 519 | 555 | 583 | 529 | 549 | 527 |
| Total | 1,411 | 1,200 | 1,086 | 935 | 934 | 928 |

In this scenario, output in the 1975-79 period is about 15 percent below recent levels of private output in Humboldt-Del Norte. The decline continues until 1990 and then stabilizes at 400 million board feet, about 40 percent of recent output levels. This scenario, when combined with stable output for Mendocino-Sonoma, results in a declining regional output trend that levels out in 1990 at 60 percent of recent output levels. With this scenario, new stands would be needed in 2005 to maintain the harvest beyond that time.

Most of the scenarios developed indicate declining output and uncertain future for the timber economy of the North Coast region. Part of the uncertainty is due to the term of the study, which is 25 years. The future beyond 25 years, though uncertain in the eyes of this study, need not be considered uncertain in a negative sense. Quite a bit is known or can be inferred about the 25-year future of the region's output because the basic ingredient, its existing sawtimber and poletimber stands and their characteristics, are known. But beyond the period of their availability little is known.

In 1967, the region had 850,000 acres of private timberland either unstocked, stocked with hardwoods, or with conifer seedlings. The 298,000 acres of private lands harvested since 1967 have stand or stocking conditions unknown at this time. Combined, these areas total 1,148,000 acres or 41 percent of the privately owned commercial timberlands. Little is known of the current condition of many of these lands. But the effectiveness of man's management and perhaps nature's contribution on many of these lands and on the hundreds of thousands of acres that will be harvested in the next two decades will determine the longer term condition of the forest enterprise in the North Coast region.

## *IMPACTS OF MAJOR ASSUMPTIONS*

This study of necessity has included many assumptions, some of which might have a significant impact on the projected outputs. The assumptions that can be expected to have impact on projected timber output are generally of two types; those that affect amount of yield on a per-acre basis and those that affect the timing of yield (the availability of stands for harvest).

The yield predictions are based upon an initial condition for each stand or timber class, assumptions about how each stand will grow and develop, and an additional assumption about extent of utilization when harvested. The predicted yields (table 4) were based upon stand condition and growth data from comprehensive inventories of the region's forests. Since projected output is directly related to per-acre yields, changes in the yields would lead to directly proportional changes in projected outputs.

The assumption that all acres cut from 1967 to 1974 had all of their volume removed has an unknown impact on future sawtimber supplies because the amount of sawtimber residuals on some of these lands that were not clearcut is unknown. The majority of plots that were cut, however, were either clearcut or had only seed trees remaining. If an average of 15,000 board feet were left on one-third (100,000 acres) of the area harvested, an additional year of harvest at recent levels--1.5 billion board feet--would be available.

The use of the clearcut assumption for the projected harvests likely has little different effect than if substantial partial harvests were assumed. Available evidence on the West Coast indicates that such harvests in mature stands do not increase total yields; it merely spreads them over a period of time (Chambers 1977, Reukema 1972, Reukema and Pienaar 1973). Consequently, simulations of partial harvests of more acres with final harvests at a later date will result in similar output projections to those achieved assuming clearcuts on fewer acres.

## *SCENARIO X*

The use of a 10-year period for liquidation of each sawtimber class might conceivably have some impact on the amount of output potentially available, although the use of many classes would seem to minimize the impact of this assumption. As a limited test, a scenario was developed in which first the five high-use classes, then the rest of the classes (high volume first) were harvested, each in 5 years. The impact of the 5-year harvest assumption can be determined by comparing this scenario with Scenario III. The outputs by 5-year period are very similar to Scenario III until 1995, but then the 5-year rule allows more flexibility, and available sawtimber classes are used at a more rapid rate. Other "rules" regarding duration of harvest by class would also have some impact on the sequence of acres harvested.

|  | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Sawtimber (MMBF) | 1,494 | 1,488 | 1,512 | 1,494 | 399 | 0 |
| Acres harvested | 26,478 | 44,373 | 63,348 | 139,638 | 52,602 | 0 |

But the magnitude of total outputs probably wouldn't differ considerably from those presented here.

## *SCENARIO XI*

An earlier draft version of this study had a major assumption that sawtimber stands would not be available for harvest until they had a minimum of 10,000 board feet. Many reviewers expressed the opinion that this was unrealistic, because it excluded over 500,000 acres of residual and seed tree sawtimber that would be harvested in the near future. Consequently, the scenarios have been revised to reflect a 5,000-board foot minimum, which results in availability of all poletimber and sawtimber stands, including the light residual stands and those with scattered seed trees, during the projection period. For comparison purposes, the following scenario uses the 10,000-board foot mimimum for availability. This scenario harvests the five high-use classes first, then other classes on a high volume first basis; each class is harvested over 10 years. Except for the minimum volume per acre standard (10,000 board feet versus 5,000 board feet) this scenario is identical to Scenario III. Comparison with Scenario III indicates that total yield over the projection period is about 2.9 billion board feet less with the 10,000-board foot minimum cutting restriction.

|  | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|
| Sawtimber output (MMBF) | 1,483 | 1,489 | 1,190 | 1,193 | 160 | 194 |
| Acres harvested | 37,306 | 34,173 | 63,362 | 60,228 | 15,324 | 15,324 |

The 5,000 board foot minimum assumption, basic to all study scenarios except Scenario XI, results in "harvest" of essentially the entire private inventory of softwood sawtimber and poletimber over the next 30 years. Given the ownership and condition of many of those lands, it might be deemed unlikely that the timber on all of them will be economically available. In this respect, the basic assumption on availability is very optimistic.

The impacts of many other assumptions will not be pursued here, for it doesn't seem likely that they would have a significant impact on the outcome of this study. In the final analysis, the extent of the region's sawtimber resource and its rate of use are the major determinants of the study's outcome, and they were measured or observed, not assumed.

## *OUTPUT OF SAWTIMBER FROM PUBLIC LANDS*

Although the North Coast region's timber economy is dominated by output from the private sector, the prospects outlined in the scenarios can be better evaluated in terms of their potential impacts if the reader is informed about probable outputs from public lands. The National Forests in and adjoining the North Coast region have and will continue to produce softwood sawtimber available for processing by the region's forest industries. The patterns of timber flows will likely be sustained, due to the location of those resources with respect to location of processing centers. The amounts, however, are subject to fluctuation from year to year. In 1972, timber originating on four National Forests was processed in the region's mills (Howard 1974).

| | National Forest of Origin | | | |
|---|---|---|---|---|
| | Klamath | Mendocino | Shasta-Trinity | Six Rivers |
| Timber processed in region (MMBF) | 34 | 27 | 38 | 161 |
| Percent of Forest total processed in region | 15 | 35 | 10 | 87 |

Of these Forests, only the Six Rivers and the Mendocino have significant area within the boundaries of the region. It is probable that most of the Six Rivers' harvest and a substantial proportion of the Mendocino's harvest will continue to be processed in the North Coast region. Significant amounts of timber from the western portions of the Klamath and Shasta-Trinity National Forests will likely continue to move to processing facilities in the eastern part of Humboldt County. These are the same facilities that process much of the Six Rivers harvest.

The 260 million board feet that in 1972 flowed from National Forests to the region's processing facilities is perhaps the best estimate of what can be expected in the future. Two key characteristics of this source of raw material are: (1) it is predominately Douglas-fir, and (2) National Forest timber has traditionally gone to nearby plants that are largely dependent on National Forest timber. This timber has not moved to the major industrial processing centers to the west of the Forests that are now dependent on private timber. Declines in private timber output could, however, cause changes in the historic flow patterns of National Forest timber in the region.

Other public lands, wholly within the region, have contributed a significant amount of timber to the total harvest. This output has come primarily from the Jackson State Forest in Mendocino County, the Hoopa Valley Indian Reservation in Humboldt County, and lands managed by the Bureau of Land Management (BLM). The investigation of acres harvested since inventory indicated that from 1967 to 1974, these public lands produced an average of 115 million board feet per year. In 1972, these "other public" lands produced 98 million board feet of timber for processing. In recent years, however, the allowable harvests on State, Indian trust, and BLM lands in the Region have been reduced. The combined allowable harvests for these "other public" lands is now 71 million board feet, down from 102 million board feet. This new allowable harvest can be sustained from current stocks of sawtimber well into the next century, and is probably the best estimate available of future outputs from these lands.

For all public lands within and adjoining the region, a reasonable approximation of future output is about 330 million board feet. The output from "other public" lands won't likely increase, because the reserves of growing stock have been used in recent years. National Forest output is the subject of much debate; that debate centers around the merits of even flow vs. accelerated liquidation of old timber with more rapid replacement by young stands. But changes in allowable harvests have usually been gradual. And even radical changes in output resulting from major changes in law and policy would likely have only a nominal effect on total raw material output. For instance, a 50-percent increase in output from National Forests, if captured by the region's mills, would increase the flow of timber into the mills by 130 million board feet, only 7 percent of recent sawtimber output levels for the region. It appears that output from public lands will not offset the prospective declines in private sawtimber output in the region.

If it is assumed that public lands will provide a constant output of 330 million board feet of sawtimber, the range of total regional outputs for several scenarios is as follows:

| | Public and private output (million board feet) | | | | | |
|---|---|---|---|---|---|---|
| | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
| Scenario I | 1,859 | 1,837 | 915 | 672 | 492 | 503 |
| Scenario II | 1,030 | 1,830 | 1,811 | 1,763 | 862 | 354 |
| Scenario III | 1,813 | 1,819 | 1,011 | 1,854 | 471 | 494 |
| Scenario V | 1,546 | 1,377 | 1,225 | 1,207 | 1,187 | 1,215 |
| Scenario VIII (combined) | 1,080 | 1,711 | 1,009 | 930 | 945 | 866 |
| Scenario IX (combined) | 1,741 | 1,538 | 1,416 | 1,265 | 1,264 | 1,258 |

## CONCLUSIONS

Do all of the scenarios, or any of them, tell us what is going to happen to softwood sawtimber output from private lands in the North Coast region? Probably not. Many key and perhaps artificial assumptions have been made for each scenario. What can be drawn from the scenarios is a range of potential outcomes which may prove informative to those who have an interest in the region and its timber economy.

Perhaps of more value than the specific outcomes of any of the scenarios are the following generalizations that might be drawn from the study:

(1) Output of softwood sawtimber from the North Coast region's private timber lands will likely decline substantially in the next 10 to 15 years.

(2) The major portion of the decline in private timber output will be centered in Humboldt-Del Norte Counties.

(3) No reordering of cutting priorities among different types of stands will have a significant impact on the prospective falldown in output.

(4) Output will decline in both Douglas-fir and redwood stands.

(5) There are not sufficient sawtimber stocks with associated growth to maintain output until new stands, regenerated since the mid-1950's, can reach merchantable sawtimber size.

(6) Forest industry timberlands, which account for two-thirds of the region's private timber output, will evidence decreases in output within 10 years. Output from miscellaneous private timberlands can be maintained throughout the study period, if all of these lands are available for timber production.

(7) Output of sawtimber from public lands within and adjoining the region is not likely to offset declines in the private sector, but will become more important as total sawtimber output declines.

In the near term, little can be done to change the total amount of sawtimber that will be physically available for harvest. There are many possibilities as to how it might be harvested over time. But in the final analysis demand in the product markets will probably be the major determinant. In the longer term, however, virtually every acre of unreserved commercial forest land is a potential producer of sawtimber or other roundwood products. This study has not addressed the potential for that more distant future. But further efforts to study the region's timber resource prospects will likely prove most fruitful if they are so directed.

In the next few years many choices will be made regarding development and management of the region's forests; those decisions will have an impact on the new forests that will be developing. New inventories of forest resources are needed to provide an updated picture. These new inventories should take stock of current timber resources, as did the previous inventories. But they should also be designed to identify the condition of the region's forest lands with respect to the formation of future forests. They should provide the information needed to identify opportunities for management as well as problems, if they are to provide the basis for sound decisions that will result in the North Coast region's future forests.

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